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REPORT ON THE WORKSHOP

ON ION IMPLANTATION AND ION BEAM

ASSISTED DEPOSITION

CORPUS CHRISTI, TX, MARCH 9-11, 1992

March 1992

Ref. No. R&D 6907-EE-06

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This workshop was organized by the Corpus Christi Army Depot (CCAD), the major helicopter repair base within AVSCOM. Previous meetings had revealed a strong interest throughout DoD in ion beam technology as a means of extending the service life of military systems by reducing wear, corrosion, fatigue, etc.

About 40 DoD representatives were present, with a preponderance from the Army, together with a number of vendors: I was the only person invited from overseas.

After the usual introductions, the workshop opened with an account by Dr Bruce Sartwell of the successful application of ion implantation to bearings and gears at NRL, and the checkered history of the MANTECH Project at Spire Corporation (significantly, no-one from Spire was present).

Dr James Hirvonen (AMTL) continued with a summary of successful applications to reduce wear in biomedical components, and he also described the processes of ion beam-assisted deposition (IBAD) for a variety of protective coatings, including diamond-like carbon (DLC).

Next there was a presentation by Alonzo Gonzales (CCAD) of the work carried out on machine tool inserts and other items, such as end mills, drills, taps and reamers used at the Depot. In all, some 2000 implanted tools have been tested, with typical improvement factors in life from 2X to 4X. I pointed out in discussion that these results have not yet been optimised, and that there is the likelihood of doubling these improvement factors, e.g. by research planned at Harwell. The annual CCAD expenditure in tooling is $800,000 per year, and this is likely to be halved by ion implantation. Applications to engine components, bearings etc. can bring much greater benefits, after validation (by AVSCOM). CCAD is considering purchase of a nitrogen ion implantation machine, and it was revealed that a quotation has been received for $180,000 for a small nitrogen implanter.

Keith Hensley (Implant Sciences Corporation) gave an excellent presentation, describing successful work carried out for industrial customers on tools and components. In some instances 15X normal life had been obtained, e.g. in cutters for polymeric composites.

On the second day, Prof. John Conrad (University of Wisconsin) described the method of plasma source ion implantation, which is best used when high temperatures can be tolerated. The process is than a synergistic combination of plasma nitriding plus nitrogen ion implantation.

Dr Jim Treglio (ISM Technologies. Inc.) described work involving metal ion implantation, e.g. into machine tool inserts. He reported recent work from Russia, by Didenko (but this is contentious and may not apply to "real" materials!). I felt that this talk may have left the DoD attendees confused rather than informed.

Dr Ulric Lindholm (SwRI) outlined the plans for a jointly-financed 3rd generation ion beam facility at SwRI, San Antonio, TX, in close association with AEA Technology's Harwell Laboratory, U.K. This will comprise not only a large fully versatile 230 cubic foot ion beam facility (by far the largest in the USA) but also the very extensive capability for materials expertise, testing and characterization that exists at SwRI, and at Harwell, England. Dr Lindholm conveyed the view that this was a very timely development for the USA and that it was intended to service the interests both of industry and DoD.

After acknowledging the support of the US Army's European Research Office, I took up the story at this point, reviewing the 27 year history of ion beam technology at Harwell to the present day, emphasizing recent developments such as ion-assisted diamond-like carbon (DLC), which is to be a major activity in the joint project at San Antonio. I also described the requirements for successful transfer of technology (such as this) from the laboratory to full-scale application, in the light of the British Project SAPPHO, which identified the role of "champions", and the recognition of user needs as being of paramount importance. Al Gonzales at CCAD is certainly such a champion!

My only criticisms of this Workshop were that it focused primarily upon **metals** and yet there are many DoD requirements in **polymers** (canopies, etc.) and **composites** that could have been addressed, given its scope. Secondly, attendees were not well advised to bring printed material with them for distribution. There was, however, ample time for discussion - which was often lively, being led by Major Stephen Zaat, Ph.D. (AVSCOM), who encouraged others to speak up. This was a first-rate Workshop in regard to the interplay between speakers and attendees, and the feed-back, both formal and informal, during the event.

On the third day (March 11) there was arranged a tour of the CCAD facilities, which are very impressive. Besides the scale of the operation, we were impressed by the vigor and effectiveness of the Quality Circles (from which this application of ion beam technology arose), and the meticulous monitoring and documentation of every individual helicopter component or bearing constituent. This has already contributed greatly to the success of the blind trials of ion implanted tools at CCAD, and the strong "championship" spirit prevails strongly. CCAD is to be congratulated on organizing a first-rate Workshop, and on carrying the flag for ion beam technology in DoD.